Dinas Dinlle

Highlights

A remarkable site showing spectacularly folded and faulted Devensian glacigenic sediments. Such effects have been attributed to the Late Devensian ice advance over previously deposited till and gravels.

Introduction

Dinas Dinlle [SH 436 563] is a coastal exposure through a complex drift sequence which provides possible evidence for a readvance of Late Devensian ice. It was first investigated by Reade (1893) and later in some detail by Jehu (1909). The site has also featured in studies by Synge (1963, 1964), Saunders (1963, 1968a, 1968b, 1968c, 1968d, 1973) and Whittow and Ball (1970).

Description

The sections at Dinas Dinlle are cut through two large drift mounds, the northernmost of which approaches 25m in height. The sequence extends laterally for about 900m and comprises a complex series of tills and associated fluvioglacial sediments. Below this sequence, a lower till of limited extent is sporadically exposed. This red to purple weathered till (blue to grey in its unweathered condition) is thought to extend beneath the foreshore. It is a tough, homogenous and highly calcareous deposit. The thick sequence of stratified sands and gravels above contains marine shell fragments. These deposits are often coarse with the upper horizons iron-stained. Well developed iron pans are displaced by faulting. These sands and gravels form almost the entire southern drift mound. Both the lower till and the sands and gravels are affected by isoclinal folds, accompanied by thrust and reverse faulting in the northern part of the section — see (Figure 28). This steep bedding which approaches 80° is replaced to the south by more gentle folding and the beds are arranged in a low anticline. The sands and gravels are succeeded by a yellow-grey, stony upper till. A weathering horizon up to 0.5m thick and showing deep iron-staining, induration and frost-heaving has been described between the upper till and the underlying sands and gravels (Saunders 1968a, 1968c, 1968d), and this was considered to mark a stratigraphic break between these two units. The upper till is also cryoturbated in places and it is overlain by hillwash sediments and blown sand.

Interpretation

Major differences in interpreting the sediments at Dinas Dinlle have occurred. Reade (1893) first described the sections in detail and considered that the till deposits were conclusive evidence of former glacial conditions. The sands and gravels, however, had formed by marine submergence. In contrast, Jehu*(1909) interpreted the same sequence in terms of the tripartite scheme, with two major glacial episodes separated by a more temperate, possibly interglacial, period. The concept of marine submergence to account for the sand and gravel horizons was finally abandoned and the sediments were interpreted by Jehu (1909) as being fluvioglacial. The occurrence of marine shell fragments in the upper till, together with common Chalk flints, pebbles of Ailsa Craig microgranite, Goat Fell granite (Arran), Dalbeattie granite, and schists and serpentinites from Anglesey was taken by Jehu to indicate that the deposits had been derived from the Irish Sea Basin to the north.

Synge (1963, 1964) also recorded two tills separated by sands and gravels. He suggested the lower till and associated sediments were probably Saalian in age but that the upper till was Weichselian (Late Devensian) and was associated with the nearby Bryncir-Clynnog moraine; a moraine which he considered marked the maximum extent of Late Devensian ice in northwest Wales. Synge (1963, 1964), however, made no mention of the glaciotectonic structures at Dinas Dinlle.

Like previous workers, Saunders (1963, 1968a, 1968b, 1968c, 1968d, 1973) also recognised two tills at Dinas Dinlle separated by waterlain sands and gravels, but suggested these beds had been folded as a result of pressures exerted by the advancing ice which later deposited the upper till. Fabric analysis (Saunders 1963, 1968b, 1968d) showed that the lower till was deposited by ice moving north-west to south-east and that the later advance was from north-east to south-west. A study of clast lithology by Saunders (1963, 1968d) also tended to confirm a generally northern (Irish Sea) origin for the sediments, many of the rock types being derived from Anglesey. Indeed, the disposition of the glaciotectonic structures themselves provided strong evidence that the second recorded ice advance came from the northeast. Of significance was Saunders' (1968a, 1968c, 1968d) recognition of a weathering horizon between the upper Irish Sea till and the underlying coarse outwash sands and gravels. This evidence together with radiocarbon dates from other Late Pleistocene sites on Ll■n suggested to Saunders that the lower till was Late Devensian in age, while the upper till could be attributed to a later readvance of Late Devensian ice, then correlated with the Scottish Readvance (Saunders 1968a). The Late Devensian readvance, according to Saunders, was therefore responsible for the upper till at Dinas Dinlle and for contorting the underlying fluvioglacial sediments and the lower till. This readvance was also considered to have produced the upper northern till found along much of the north Inn coast, for example at Gwydir Bay, and the Bryncir-Clynnog moraine.

Simpkins' (1968) work in central Caernarvonshire did not extend to Dinas Dinlle, but it is clear that the tripartite succession is broadly comparable to that at Gwydir Bay and elsewhere along the north Ll■n coast (Simpkins 1968). The lower till at Dinas Dinlle may be broadly equated to the Trevor Till, the sands and gravels to the Aberafon Formation and the upper till to the Clynnog Till. Simpkins (1968) suggested that this tripartite sequence was probably the result of an oscillating Late Devensian ice margin rather than the result of two distinct glacial episodes separated by interstadial conditions proposed by Saunders (1968a, 1968c, 1968d).

Whittow and Ball (1970) outlined a broadly comparable sequence of events at Dinas Dinlle to Saunders (1963, 1968a, 1968b, 1968c, 1968d), although they considered the upper till to be Welsh (from a Snowdonian ice stream) rather than of northern (Irish Sea) origin. They argued that the sections represented the northernmost occurrence of the Trevor Till, deposits of this advance being excluded from the remainder of Arfon due to the magnitude of the Welsh ice cap of the equivalent Criccieth Advance. Like Whittow and Ball (1970), Bowen (1974) cited the glaciotectonic structures at Dinas Dinlle as evidence for a Late Devensian readvance of ice in North Wales, although he disputed the validity of the sample used by Foster (1968) for radiocarbon dating from the Bryncir area.

Dinas Dinlle shows some of the most convincing evidence in north-west Wales for a readvance of the Late Devensian ice-sheet. Although sections characteristic of the tripartite sequence in northern L1rn occur at Dinas Dinlle, the sequence is more completely exposed at nearby Gwydir Bay. It is the large-scale glaciotectonic structures which make Dinas Dinlle especially significant, because they have been used as evidence in support of a Late Devensian readvance. Work at Glanllynnau in southern LlSin (Boulton 1977a, 1977b) and on contemporary glacial environments (Boulton 1972; Boulton and Paul 1976) has shown that multiple till sequences similar to that at Dinas Dinlle, with associated folded and faulted structures, are common features of supraglacial landforms and sediment associations — and need not therefore be the product of multiple glaciations. However, the glaciotectonic structures at Dinas Dinlle vary considerably from those at Glanllynnau, indicating that they were not formed in the same manner. In particular, the large thrust blocks of till, the steeply dipping gravels and sands and the overthrust structures at Dinas Dinlle are more easily explained as the result of stresses caused by a readvance of ice associated with the upper till. Boulton's simple model of ice wastage would not seem to be applicable to Dinas Dinlle. The site is therefore fundamentally important in demonstrating that the wastage of the Late Devensian ice-sheet in northwest Wales was not a uniform process, being interrupted by a readvance of the ice front.

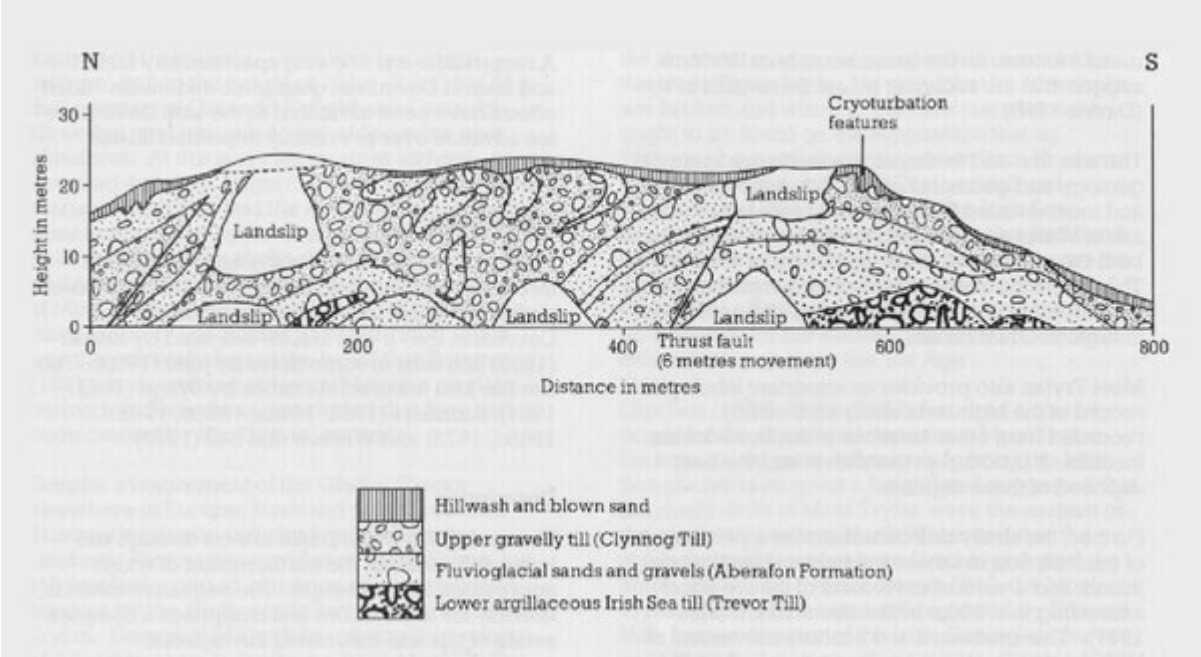
Although clast lithology and fabric studies at Dinas Dinlle have not been conclusive, there is an indication that the lower till was deposited by Irish Sea ice moving north-west to south-east, while the upper till was probably deposited by confluent Irish Sea and Welsh ice moving south-westwards. Dinas Dinlle is the northernmost known occurrence of the lower (Trevor) till, and the lithostratigraphic record therefore helps to delimit the patterns of ice movement during both of the glacial advances which occurred during the Late Devensian.

Glacigenic sediments here provide important evidence for the sequence and pattern of movements of Irish Sea and Welsh ice masses during the Late Pleistocene. Although evidence for renewed glacier activity following wastage of the Late Devensian ice-sheet has been shown to be equivocal in some areas of Great Britain, Dinas Dinlle is notable for the fine series of glaciotectonic structures which provide evidence for a possible readvance of the Late Devensian ice-sheet in northwest Wales.

Conclusions

The glacial sediments at Dinas Dinlle show evidence for major structural deformation. This was caused by some form of overriding by an ice-sheet. This may possibly have been caused by a marine-based ice-sheet grounding on the margins of the land.

References



(Figure 28) Quaternary sequence at Dinas Dinlle (from Whittow and Ball 1970)